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ABSTRACT

Part one of this survey of special projects in computer applications to education is a resource guide to computers and education in Germany. A directory-type outline is provided for 13 projects in the areas of computer assisted instruction (CAI) and clinical training, adaptive tests, instructional analysis and synthesis of CAI programs and courses in physics and mathematics, CAI as a tool for instructional research, computer assisted training, and implementing individualized learning. Information for each project includes: (1) address, staff, and financing; (2) computer hardware, software, storage, use and programs; (3) audiovisual aids; (4) project areas; (5) media-based courses; (6) evaluation; and (7) documentation. (KP)

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File on the Computer in Education in Germany(1)

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EDITOR'S NOTE

On Special Studies of Computer Applications to Education

Computers and Education in Germany - PART I

As the information is quite large, the survey on the German projects will be published in two parts.

The survey on the Belgian projects will be published by the end of March.

SUMMARY OF PROJECTS

1. Endausbau des Aachener CUU-Systems und Entwicklung neuer Teachware-Pakete als Bestandteile Unterrichtswissenschaftlicher Forschung zum CUU

(Implementation of Aachen CAI system and development of new teachware packages inclusive in pedagogical research into CAI)

Adresse
Institut für Erziehungswissenschaft und Rechenzentrum der Rheinisch-Westfälischen Technischen Hochschule Aachen
Eilfschornsteinstraße 16
D 51 Aachen

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--42-6017

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Staff
Klaus Breuer
Anne Jansen
Wilheim Keller — Teachware
Helmut Straube

Josef König
Hans Schnettker — System
Walter Ullrich

Financing
Bundesminister für Forschung und Technologie, Bonn

Hardware
University's own computer :
Control Data CD 6400
Project's computer : AEG-Telefunken TR 86

Software
MOD-ALGOL : - Compilation language
- Compilation on CD 6400
- Running programs on TR 86 with operation system implemented in the Center (in TASS)

Storage
32 K words on TR 86
tapes and disks

Audiovisual aids
Media : Slides; sound recordings

Purpose : illustration; livelier courses

Criteria used for the choice of the media
Pedagogical factors

Project areas
The project emphasized :
- Developing and testing a self-managed teachware system including :
  . learning and using the ALGOL 60 programming language
  . minimizing logical expression
  . information about "legasthenics"
- substitution for the Tübingen CAI unit, "statistics for social sciences"

Revising pedagogical objectives permitted development of programs based on analytical and didactic schema. The programs were then tested. Matching groups were used. Results showed the effects of the project, which was carried out predominantly by education students.

Media-Based Courses
- Statistics for social sciences (advanced level)
  contents : planning and carrying out empirical research
  participants : 100 social sciences students
- Familiarization and use of ALGOL programming language (introductory course)
  Contents : construction of simple ALGOL language computer programs, emphazing need for syntax and logic.
  Participants : 40 students in diverse fields
- Minimization of logical expression (Research program)
  Contents : manipulating symbols within a framework of Boolean algebra
  Participants : 50 students in diverse fields
- Information program on legasthenics (advanced course)
  Contents : application of legasthenic information to analyse case studies of legasthenic students
  Participants : 130 education students

Modes of computer use
Tutorial dialogs, drill and practice , diagnostic tests, information retrieval, problem-solving.

Evaluation
1. System : flexible and reliable
2. Programs : testable and effective
3. Students :
   a. results - obtained
   b. attitudes - highly positive

Additional sources of information
DV. im Bildungswesen
FEoLL - Information

Documentation
- Forschungsberichte der CUU-Gruppe Aachen
- Information des Projektträgers DV im Bildungswesen, Bd. 1/75

2. CUU-PROJEKT Augsburg

(CAI project at Augsburg)

Address
Zentralstelle für Programmierten Unterricht
an bayerischen Gymnasien
Schertlinstraße 7
D 89 AUGSBURG

Telephone
0821/573011

Director
Dr. Karl-August Keil, Studiendirektor

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Dipl. Math. Wolfgang Thum
Johan Stadler — DV-Abt.
Hans Grötsch
Oberstudienrat Bernhard Brockmann
Oberstudienrat Kilian Keidel — Mathem./
Oberstudienrat Giselbert Kosmala — Physik
Studienrat Werner Lehnhart

Studiendirektor Dr. Herbert Burkhart
(Chemie/Biologie)
Oberstudienrat Hans Biehringer (English)
Dipl.-Psych. Udo Karl (Begleituntersuchungen)

Financing
Bundesministerium für Forschung und Technologie;
Bayerisches Staatsministerium für Unterricht
und Kultus

Hardware
Project's own computer : SIEMENS 4004/45-3
(128 KBytes)
3 disks units 4578/79 (29 millions Bytes each)
2 dual magnetic tape drives 451-2
Card reader 4239-30
High-speed printer 4245-1
Data transmission control 4666
26 VDU display unit 8150

Software
Operational system BS 10000 System CAI - LIDIA

Storage
- 60 KBytes
- CAI programs on disk
- Students answers on tape

Audiovisual aids
Media : Texts
Programmed textbooks

Purpose : giving information, exercises,
additional information

Project areas
- Developing different programs for CAI at the high school level
- Testing CAI within the school situation, integrating it into the regular program
- This experiment was done mainly at the Anna-Gymnasium, Augsburg, a school with 1150 students
- Each week about fifty students from other schools joined the project.
- Between 15.000 - 20.000 hours per year were spent at the terminals, mainly in mathematics physics and chemistry. Trials in English, Latin and Biology were carried out to a lesser extent.
- Methods included exercises, tutorials, simulations, games and problem-solving.
- The program emphasized learning by discovery. Depending on the nature of the program, students could work independently by twos or in small groups.

The CAI LIDIA system, from the SIEMENS firm, was tested, as were some other minor programs. An evaluation program, DIDAS, was developed and built in. Testing and evaluation were carried out simultaneously.

Media-based courses
- Basic algebra
  Contents : introduction to algebra
  Participants : 7th grade students
- Basic trigonometry
  Contents : introduction to trigonometry
  Participants : 10th grade students
- Advanced fractions
  Contents : arithmetic of fractions
  Participants : 6th grade students
- Basic physics
  Contents : introduction to physics
  Participants : 9th grade students

Modes of Computer Use
Tutorial dialogs, drill and practice, simulation, information retrieval, problem-solving, computer augmented lectures.

Evaluation
1. System
dependable and uninterrupted
LIDIA allows almost all of the CAI programs to be used. Only interactive programming and a few other minor aspects are excluded.

2. Programs
Up-to-date and diversified

3. Students
Results : clearly much higher for older students than normally obtained
Attitudes : very positive towards CAI
younger students : enthusiasm
older students : varied attitudes

Computer Programs and related Materials
Approximately 150 programs in the subjects cited above are available, covering approximately 150 class hours. Average working times vary widely. They are designed for students from 10 to 19 years old. During the last three years these programs covered 45,000 terminal hours. Accompanying written material is required for some programs.

Additional information is available from : Projektträger DV im Bildungswesen FEoLL, Paderborn.

Documentation
- DV im Bildungswesen FEoLL-Information 2/1974
- K.A. KEIL Lernen mit LIDIA; in : Freibichler H., CUU, Hannover 1974.
- K. KEIDEL Computerunterstützter Physikunterricht. in : Physik und Didaktik 3/1973, Bayerischer Schulbuch-Verlag, München
- B. BROCKMANN Computerunterstützter Physikunterricht in : AV-Praxis 1/1974, Hering-Verlag, München
- K.A. KEIL Problem solving by means of stored models in CAI-project Augsburg; in : Computers in Education part 2, S. 883-887, IFIP-Konferenz und 1975, North - Holland-Publishing Company, Amsterdam.

3. PROJEKT CUUK (Computerunterstützter Unterricht in der klinischen Ausbildung)

(Computer Assisted Instruction in clinical training)

Address
Institut für Didaktik der Medizin der Rheinischen Friedrich Wilhelm Universität Bonn
Robert-Koch-Str.
D-53 BONN - Venusberg

Telephone
02221/192892

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Dr. med. K. Glänzer
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Dipl. Math. J. Pintz
math. techn. Ass. C. Wegner
math. techn. Ass. R. Korf

Financing
Bundesministerium für Forschung und Technologie; FEoLL.

Hardware
University's computer :
IBM 370/168 - visual display unit IBM 3270 (4 terminals 3277)

Software
OS/MVT
TSO (Fortran IV, PL/1, SIMULA, BASIC)
COURSEWRITER III, Version 3

Stockage
CW III : 128K with a spare disk on IBM 3330

TSO : 100 K per participant and spare disk

Audiovisual aids
media : 1. slide projector Kodak carrousel (random access)
2. configuration - EKG
3. handbook (with graphics, tables)

Purpose 1. visual aid to CAI programs (OPHTA, Hämat)
2. addition to CAI Program (CPR)
3. addition to CAI program (ACIBA)

Project areas
Evaluation of the American CAI programs of clinical training

In January 1976, 30 students worked at the terminal for one to two hours. In 1976, four parti al projects were worked out.
-integrating CAI into ordinary teaching example : establishing the balance of an aqueous/electrolytic medium
-use of CAI in a cardiology course (patient examination and care)
-developing an instrument for rational decision-making in diagnosis and therapy.
-acquisition and evaluation of other CAI programs designed abroad.

Media-based courses
- CPR (advanced course, USA)
  Contents : reanimation
  Participants : 3d section of clinical studies
- HAEMAT (advanced course, USA)
  Contents : hematology
  Participants : 2d section of clinical studies
- MACPEE (advanced course, CANADA)
  Contents : blood circulation, kidneys, metabolism
  Participants : 2d section clinical studies
- OPHTA (advanced course, USA)
  Contents : ophtalmoscopy
  Participants : 2nd section clinical studies (30 students)
- BILANZ (advanced course, CANADA)
  Contents : aqueous and electrolytic media
  Participants : 2d & 3d sections clinical studies.
- Cardiology (advanced course, CANADA)
  Contents : heart examination
  Participants : 3d section clinical studies
- Heart auscultation I* (basic course, estimated)
  Contents : heart examination
  Participants : 1st section clinical studies
- Heart Auscultation II* (advanced course, estimated)
  Contents : heart examination
  Participants : 2d section clinical studies

*Audio-visual system without computer as preparation for CAI (Total : 800 students)

Modes of Computer Use
Tutorial, drill and practice, Simulation, Computer-Augmented Lectures.

Evaluation
1. System : technique is excellent but difficult to organize
2. Programs : MACPEE, MACPUF, MACMAN : very good
OPHTA : adequate
one part remains untested
3. Students : Objectives not yet defined
attitudes : positive toward OPHTA

Computer Programs
MACPEE, MACPUF, MACMAN : simulation of physiological processes

HAEMAT, OPHTA, ACIBA, TERMS, CVTERMS : tutorial programs

CPR : Mixed program, tutorial and drill and practice

Students : medical students during clinical training.
The data and results obtained during the time of utilization are still incomplete and cannot express general conclusions.

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4. PROJET PROKOP

Computer als Hilfsmittel des Schülers bei aktivem Lernen - Ein Projekt zur Erprobung problemorientierter Rechnerbenutzung in Kooperation mit Lehren

The Computer as an aid to the student by active learning. A project for a tentative computer utilisation oriented towards problem analysis in cooperation with the teachers.

Adresse
Forschungsgruppe CUU
- Projekt PROKOP -
Vogelsbergstr. 50
D-61 DARMSTADT

Telephone
06151/75018-9

Director
Dr. Ulrich Kling

Staff
Dipl. Psch. Heinz-Dieter Böcker
Dipl. Math. Gerhard Fischer
Dipl. Informatiker Hartmut Hille
Dr. Ing. Ulrich Kling
Dipl. Psych. Andreas Laurenze
Stud. Ref. GÜnter Sauer

Financing
Bundesministerium für Forschung und Technologie; Kultusministerium des Landres Hessen

Hardware
University's own computer
1. PDP-1P (128 K words
2. Telefunken TR440 (512 K words)
Project's own computer
3. NOVA 2/10 with 10000 K-Byte-disk (32 K words)

Software
1. LOGO, PPL, PASCAL
2. FORTRAN, BASIC, ALGOL, LOGO
3. BASIC

Storage
1. 500 K words (disk)
2. 300 K words (disk)

disks and tapes (TR440)

Audiovisual aids
Media : LOGO Turtle Set (implemented by laboratory for artificial intelligence, Massachusetts Institute of Technology, USA)
1 robot under computer commands
1 music box
1 graphic display

Purpose : visualization of programed processes and structures; experiments with the music box.

Criteria used for the choice of the media
experience based actice learning

Project areas
This project investigates the extent to which students can make independent use of a computer. This includes devising and testing original programs to use exercise-solving, problem-solving and simulation.

Research on the project investigated the following PI objectives

1. Deeper insight into branches of teaching other than mathematics and physical sciences
2. Awareness of the possibilities and limitations of computers - an introduction to electronic data processing or programming as a cultural technique.
3. early introduction to formal reasoning such as algorithmic logic, problem-solving, thought processes - the computer as a way for man to extend his intellectual capacities
4. improved attitudes toward learning by personalizing the learning process and emphasizing method over content.

AREAS OF INTEREST AND RESEARCH

a. Pedagogic and didactic functions
   - testing standard teaching units for CAI
   - developing a list of criteria for computer use within schools and making materials for teachers and students

b. scientific and theoretical functions
   Multidisciplinary researchers in the fields of electronic data processing, artificial intelligence and of subject matter's didactics in order to define the best uses of a computer

c. organizational functions
   - attempt to find influences on computer use in actual school situations, (ex. location of computer, additional available hardware, course hours, computer availability time, available teaching time)

d. technological functions
   study of costs of newly developed materials and software (ex. new terminals, pocket computers, new programs) developed by industry or universities.

Media-Based courses

Remark : Inasmuch as the student himself devises his program in the interactive programming(IP)problems of the most diverse natures can be handled.
The outstanding aspect of interactive programming is that the student himself writes his own program.

- IP in mechanics (integrated in a physics course LOGO, BASIC)
  Contents : physics course in mechanics completed and deepened by IP
  Participants : students of secondary level II (20 students)

- IP in the mathematics course of secondary level I (basic and auxiliary course doing group work - LOGO)
  Contents : improved and enlivened by the use of the "turtle" mathematics course
  Participants : students of the secondary level I (15-20 students)

- Statistics and calculus of probability (integrated in a math. course likely to be use in sociology - BASIC)
  Contents : statistical methods and calculus of probability augmented by computer examples
  Participants : students of secondary level II

- Introduction to programming by the study of interactive FORTRAN (basic course - FORTRAN)
  Contents : study of the FORTRAN language on the computer
  Participants : teachers, students , pupils (40 students)

Interactive problem solving using the computer (advanced course - LOGO)
Contents : problem solving, active and personal
Participants : students of secondary level II, (20 students)

MODES OF COMPUTER USE

Drill and practice, simulation, games, information retrieval, computer based laboratories, several other tools are also used (turtle, music-box, screen terminals managable by computer)

EVALUATION

1. System : for our objectives, the LOGO system is quite suitable ; it mainly favors programming of complex non-numerical problems; but it can easily be used after a few hours of teaching for simple exercises by using some turtle commands.

2. Programs : the students of secondary level I write programs for Turtle and for simple linguistic problems, etc... Students of secondary level II write complex programs for problems in such varied fields as math., data processing, linguistics, games and artificial intelligence)

3. Students : results : interactive programming spawns an active and personal learning experience.
   attitudes : because of the pressure improved on the staff by the numerous requirements at the secondary level II, research work is much more difficult.

COMPUTER PROGRAMS

- no tutorial courses.
- Programs of exercises, simulation and games; those are written in LOGO and BASIC and can be completed and added to by the students themselves.
  During certain periods, the terminals are reserved for course-work but outside of this time the terminals and their corresponding programming (LOGO, BASIC, FORTRAN and PPL) are open to users (9 - 18 h)

DOCUMENTATION

Reports and materials edited by the members of the project:

- G. FISCHER & U. KLING
  LOGO - eine Programmiersprache für Schüler inhaltliche und methodische Aspekte ihrer Anwendung; in: Proceedings "Rechner-Gestützter Unterricht", Lecture Notes in Computer Science, vol. 17, pp 290-299

- G. FISCHER
  Bibliographie zur Dialogsprache LOGO; in: FEoLL-Information 3/1974, pp 41-60

- K. BRUNNSTEIN & C. FISCHER
  LOGO im Abschlußbericht des Arbeitskreises ABAD. Zur Analyse und Bewertung heute verfügbarer Autoren- und Dialogsprachen; in: FEoLL Information 4/1974, pp. 83-87

- U. KLING
  Computerunterstützte Formen aktiven Lernens; GPI-Tagung, Wiesbaden 1974.

- K. FISCHER & U. KLING
  Schulbezogene Forschungs- und Entwicklungsaspekte des CUU in Amerika, 1974.
- U. KLING
  Computerunterstützung bei Lern- und Denkprozessen; ZAI-Tagung, Februar 1975
- G. FISCHER
  Vor- und Nachteile der Sprache LOGO für den Schulbereich; in FEoLL-Information 3/1975, pp. 5-9
- H.D. BÖCKER, G. FISCHER & U. KLING
  Projekt PROKOP: Eine Anwendung von AI; Vortrag beim Arbeitstreffen der GI-Fachgruppe Künstliche Intelligenz, Dortmund, Oktober 1975; technischer Bericht der Universität Bonn.
- G. FISCHER
  Interaktives Programmieren mit linguistischen Aufgabenstellungen; in: Weber und Weydt (Hrsg.): "Sprachtheorie und Pragmatik", Band 1 der Akten des 10. Linguistischen Kolloquiums, Tübingen, September 1975; Max Niemeyer Verlag, Tübingen
- G. FISCHER
  Fragen, Thesen und einige Erfahrungen zum Thema Schulsprache, Vortrag beim ACU-Treffen in Stuttgart, September 1975; Bildungstechnologisches Zentrum Wiesbaden, Dezember 1975
- U. KLING
  Interaktives Programmieren als Form des CUU in: Arlt (Hrsg.), "Datenverarbeitung im Bildungsbereich 1975".
- Bericht über den Einsatz des interaktiven Programmierens in einer Arbeitsgemeinschaft mit 11-13jährigen Realschülern einschließlich Dokumentation der Arbeitsmaterialien
- Bericht über einen Unterrichtsversuch zur Integration des interaktiven Programmierens im Mathematik-Unterricht (in Sekundarstufe II, Wahrscheinlichkeitsrechnung und Statistik)
- Einführung in die Programmiersprache BASIC (für Schüler mit Lehrer-Begleitheft)
- Anleitung, Arbeitsmaterialien zum Unterrichtsversuch "Integration des interaktiven Programmierens in den Physikunterricht", enthalten im Anhang des Berichtes (s.o.)
- Arbeitsmaterialen und Beispiele zu einem Kurs im interaktiven Programmieren mit LOGO
- Für kurse Einführung in LOGO
- Für den Arbeitskreis Schulsprache (ASS)
  - 5 beispiele für Mathematik (Sekundarstuffe II)
  - 5 Beispiele für Linguistik

  und verschiedene andere Arbeitspapiere
- Interaktives Problemlösen mit Computerhilfe
  Band 1: Einführung in das Interaktive Programmieren
  Band 2: Die Programmiersprache LOGO

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5. PROJEKT ABT

(Antwortabhängige Testverfahren)

(Adaptative tests)

Address
Erziehungswissenschaftliches Institut
Universität Düsseldorf
Universitätsstraße 1
D 4 DÜSSELDORF

Telephone
0211/311-3474

Director
AkR Dr. Lutz F. Hornke, Dipl. Psych., M.A.

Staff
Presently 2 research students
After some preliminary researchers, a project will be submitted

Financing
gegenwärtig aus dem Lehrstuhletat

Hardware
University's own computer
1. SIEMENS 4004-45, 256 K - Evaluation of preliminary researches
2. DIEHL-alphatronic, 4 K - implementation of computer assisted branched questionnaires

Software
1. PBS, FORTRAN IV, Software-package : SPSS, BMD DRZ-Progr., center's own program
2. Assembler

Storage
1. mglw. 110 k
2. 4 k (Other means of storage)

1. tape + disk
2. tape (cassette)

Audiovisual aids
AGFA slide projector with movector controller

Criteria used for the choice of media
Availability, economical factors

Project areas
Within the framework of "individually prescribed instruction" diagnostic tests are of great importance.

In this project, methods of administering tests more economically are examined. Two additional questions are also considered. One is the decision-making process; how to attain teaching objectives. The other question is quantitative; how to measure performances fairly and accurately.

Modes of computer use
diagnostic tests

Evaluation
1. system : adequate; for subsequent phases of development and trial, mandatory. Moreover, screen terminals would be useful
2. students : positive so far as pertinent

Computer programs
Computer programs exist only as batch processing; they have to be adapted.
Information will be available when the system is further developed.

Materials for exchange
Personal correspondence with the interested persons is currently available.

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6. PROJEKT DATENSTATION AN DER PH ESSLINGEN

(Computer Project at the PH Esslingen)

Address
Pädagogische Hochschule
Flandernstr. 101
D-73 ESSLINGEN

Telephone
0711/394238

Director
Prof. Herbert Loethe

Staff
Fachschulrat Werner Quehl

Financing
Stiftung Volkswagenwerk

Hardware
Project's own computer
PDP 8/A - CLASSIC
Digital Equipment Corp.

Software
OS8 system with BASIC, FORTRAN and ASSEMBLER

Storage
8 K
floppy disk

Project areas
Interactive programming for advanced pedagogical training :
- for the teaching of mathematics
- introduction to data-processing
- how to use the computer at school (teaching trials)
- techniques inherent to the field.

For curricular reasons outside materials were not used, instead the computer itself is the tool. Participants were students of upper technical training and professional training.

Modes of computer use
Problem solving
Computer augmented lecture

Evaluation of the system
computer too small
language BASIC and FORTRAN are insufficient for adquate teaching.

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7. PROJEKT DASYCULF

Didaktische Analyse und Synthese von Computerunterstützten Lehrprogrammen und Fernstudientexten der Physik und Mathematik

Instructional analysis and synthesis of learning computer-assisted programs and correspondence courses in physics and mathematics.

Address
Arbeitsgruppe für computerunterstützte Lernverfahren (ACUL an der Universität Essen
Henri-Dunant-Straße 65
D-43 ESSEN

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Prof. Dr. F.H. Effertz

Staff
Prof. Dr. F.H. Effertz
Dr. rer nat. E. Hörber
Dipl. -Phys. J.M. Müller
Dr. rer. nat. L. Uhlenbusch
Ing. H. Waßmann

Financing
Land Nordhein-Westfalen

Hardware
Company's computer
UNIVAC 9200
Connection to UNIVAC 1108
Zuse Z 25 : Nixdorf Teaching system
(Learning in small groups or individually)

Software
FORTRAN V
ALGOL 60
NUALG

Storage
Disk or tape

Audiovisual aids
Media : sound recordings, slides, movies
textbooks, learning programs

Criteria used for the choice of the media
Pedagogical and economical factors.

Project areas
Successful study of computer-assisted courses, in its different application and on texts of correspondence courses, (according to the authors : R.C. Anderson, D.P. Ausubel, J.R. Bell, T.R. Davies, G. Dohmen, G.T. Tosti, G.H. Watts) definitely depends on the structure of the given courses. Developing different structures for such courses was the main point of this research. Based on trials in schools of several levels, a five phase model is suggested for groups and individuals. This model is fully explained in P.H. Efferts (Ed.) "Computerunterstützter Unterricht in Schule, Betrieb und Universität, Essen 1974.

The 5 phase model was used for university correspondence courses. It resulted in a 10 block system and a 7 element system. Both are described in greater detail below. The 2 two served as points of departure of univ. correspondence courses "basis of electronics" and "Analysis I and II", both of which are in actual use.

Other research subjects
1. attitude of teachers as to computer-assisted instruction
   Greater professionalization of instructor brought about objectivizing instructional duties.
2. Structuration of physics in regards to the learning process and problem solving.
3. mathematical description of the learning process using Fokker-Planck-Gleichung,... equation.

10 BLOCK SYSTEM FOR THE ORGANISATION OF CORRESPONDENCE COURSES

1. General project
   1.1. Objectives of course and prerequisite
   1.2. Contents of courses and syllabus
   1.3. work methods
   1.4. media used
   1.5. organization of subject matter
   1.6. evaluation methods

2. Detailed data regarding prerequisite
   2.1. aptitudes
   2.2 required knowledge of the subject (ex. mathematical background knowledge)
   2.3. information about related courses

3. Primary auto evaluation test

4. Objectives of the course (expressed in Operational terms)

5. Organization of the course (with flowchart of structure of subject)

6. Principal block (consisting of 3-4 teaching units) compare 7(8) sample items.

7. Short summary
   (with all the formulas and glossary)

8. Final examination
   8.1. auto evaluation with feedback to blocks 4,5 and 6
   8.2. outside evaluation

9. systematical bibliography
   (with short summaries)
   9.1. sources
   9.2. more detailed literature

10. Index

CHART OF 7 ELEMENTS FOR TEACHING STRUCTURE OF COURSE UNIT

(see next page)

Media based courses
- fundamentals of electrotechnics
  (basic course university)
  contents : based on textbook
  students : mathematicians with a minor in electronics (50 students)
- electronics course (basic course secondary school, year II)
  students : students training to teach secondary school physics, year II
  (± 100 students)
- mathematics and electronics course (basic course secondary school year II)
  students : students training to teach secondary school physics, year II
  (± 100 students)

Modes of computer use
Drill and practice, diagnostic tests, questionnaires, computer augmented lectures, tests of repetition and self-evaluation

CHART OF 7 ELEMENTS
FOR TEACHING STRUCTURE COURSE UNIT

Element	Contents	Didactical Function	Media	Learning Process
Element 1 Objectives	Programs, motivation Objectives of subject in operational terms	Prerequisites Indications of knowledge and aptitudes needed by correspondence student.	mail	self-taught
Element 2 information	Contents of unit with examples and solutions	transmissions of contents of subject to students	mail, slides cassettes	self-taught
3 student work	questions, homework tests and/or experiments with partial solutions or some with solutions - what do you mean	assimilation, comprehension and application package by correspondence students	mail, material for experiments	self-taught group work non-tutorial
4. self-evaluation	instructions for self-evaluation	self-evaluation and choice of method for pursuing studies	mail	self-taught group work non-turorial
5. individualization	Choice of learning blocks 1. self-correcting blocks 2. theoretical block 3. practical block	concentrated effort of self management	mail slides, cassettes	self-taught group work without teacher
6. Communication	4 components : 1. problems for tutorial group work 2. topics for seminars 4. topics for specialized discussions	1. evaluation of a two-dimensional learning structure 2. introduction to seminar themes 3. preparation of specialized discussions	mail slides, cassettes, movies	self taught group work with teacher, seminars, specialized discussions.
7. tests	summary questions, exercices tests and/or experiments	learning by repetition specification of objectives reached in this learning unit and in previous ones	mail cassettes	self taught with outside evaluation

8. PROJEKT CAT

Computer Assisted Training

Address
Projektgruppe CAT an der Fachhochschule für Technik Esslingen
Neckarstr. 65
D 73 Esslingen

Telephone
0711/356562

Director
Prof. Dr. GÜnther Kurz

Staff

Prof. Dr. GÜnther Kurz	Physik
Ing. Gerhard Volkmer	
Prof. Wolfgang Georgi	Mathematik
Ing. Robert Rühle	
Prof. Dipl. Ing. Wolfgang Schnabel	Technische Thermodynamik
Ing. Peter Stotz	
Dipl.-Math. Rainer Eggensperger	Informatik, Progr. Koordin.
Donald Macnab, B.A.M.Sc.	Begleitunter-suchung, statist.
Dipl. Psych. Heidemarie Mickasch	Auswertung

Financing
Bundesministerium für Forschung und Technologie

Hardware
Computer of the "Stiftung Rehabilitation via Datenfernübertragung"
6 teleprinters Siemens T-200
(In 1977, the use of Tektronix 4013 is anticipated)
Connection by Timeplexer T-16 Racal-Milgo via Hfd der Deutschen Bundespost.
SIEMENS 4004-151 of "Berufsförderungs werkes Heidelberg" (Stiftung Rehabilitation)

Software
BS 2000
The Project uses only APL + PLUS with a file system.
(ASSEMBLER, FORTRAN and BASIC could also be used)

Storage
2 x 140 k
4 x 40 k

Information stored on disk up to 50,000 Bytes, then stored on tape.

Audiovisual aids
Multimedia system
Media : 1. Course and textbooks
2. Exercise's sheets with solutions (used for learning in small groups and homework)

Purpose : 1. Transmission of course's contents
2. Aid to active lerning exercises

Criteria used for the choice of media
Pedagogical factors : reinforcement of the exercises sessions
a) learning in group (social stage)
b) CAI (individual stage)

Project areas
Based on 4 instruction units in the following basic disciplines - mathematics, physics and technical thermodynamics, pilot research was undertaken to see whether the use of CAI is worthwhile and permits greater efficiency in higher technical training (exception is made for computer programs which are first incomplete) The subjects are presented in a multimedia format. The forecast CAI/CAL programs will probably be written in APL and be in 2 categories : simulation - games and drill and practice.
The principal points of the project consist of introducing the CAI/CAL as an important part of education (integration aspect) and in controlling the increased efficiency resulting from the CAI/CAL (aspect of the control of efficiency)

Media-based courses
for the basic courses : math., physics, technical thermodynamics. Integrated multimedia format including some material for lectures for work in class and at home, for work at the terminal, and the testing material)
- complex arithmetic (basic course)
  . contents drill and practice programs (in: APL and PLANIT)
  Basic rudiments of complex numbers, multiplication and division of the complex numbers; decomposition in binary factors, transformation of complex numbers...
- integral calculus
- theory of vibratory motion
  . basic concept of undamped harmonic oscillation equation of motion for an undamped harmonic motion , mathematical pendulum.
  Concepts of energy regarding the undamped motion
  . content of the CAL simulation program: superposition of 2 harmonic oscillations; damped harmonic motion (oscillating type, ...)
  strained oscillation and resonance
- perfect gases

(the courses mentioned cover 20 hours of class time and exercises)
participant ; students of secondary technical education
orientation : building of machines and other equivalent training (for ex. electronics, production technique : 1-3 semesters)
Basic study

Teaching trials 1975/76 : carried out in 27 of the 70 technical secondary schools in Germany.

Modes of computer use
Drill and practice, simulation, games, problem solving, computer graphics.

Evaluation
1. system : consultation of the teachers about a larger utilization of the system
2. program : review on the basis of an investigation.
3. students : a) anonymous pretest and posttest, both non-evaluative.
b) attitudes : investigation in progress

Material for the exchange of information

- W. GEORGI, G. KURZ, H. MICKASCH, W. SCHNABEL, H. SEITZ, P. STERN, G. VOLKMER
  Projekt CAT : Abschlussbericht des Projektes p 54 der Stiftung Volkswagenwerk, Projektgruppe CAT an der FHT Esslingen; Esslingen, 1975.
- H. MICKASCH
  Lernerleistung und Lernereinstellung : Eine empirische Begleituntersuchung zu multimedialen Unterrichtsbausteinen
  Diplomarbeit, Eberhard-Karls-Universität Tübingen, 1975.
- Projektgruppe CAT an der Fachhochschule für Technik Esslingen (P 54)
  W. GEORGI, G. KURZ, P.STERN, G. VOLKMER
  Projektberichte FIM 15
  FIM-Bericht: Über den derzeitigen Stand des Projektes, über aufgetretene Probleme, über Vorgehensweisen und Erfahrungen
  Deutsches Institut für Fernstudien, Koordinierungsgruppe Tübingen, September 1973.
- W. GEORGI
  Überlegungen zur Methodik der Fachhochschulausbildung; in : Festschrift zum 10jährigen Jubiläum der Fachhochschule Ravensburg; Ravensburg, 1974.
- Projektgruppe CAT an der Fachhochschule für Technik Esslingen (P 54)
  W. GEORGI, G. KURZ, W. SCHNABEL, P. STERN, G. VOLKMER
  Projekt zur Erprobung neuer Lehrmethoden in der Ingenieurausbildung; in : Report 2 : Beiträge zur Hochschuldidaktik der Ingenieurausbildung, 1974; Studienkommission für Hochschuldidaktik an den Fachhochschulen Baden-Württembergs
- W. GEORGI
  Ein Unterrichtsbaustein im Medienverbund für Fachhochschulen (FH) im Fach Mathematik : Komplexe Mathematik; in : Referate des 13. Symposiums der GPI (Nürnberg); 1975
- G. KURZ und G. VOLKMER
  Ein Unterrichtsbaustein im Medienverbund für Fachhochschulen (FH) im Fach Experimentalphysik : Schwingungslehre; in : referate des 13. Symposiums der GPI (Nürnberg); 1975

Printed material for coursework and group for the 4 training units.

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9. PROJEKT COMPUTERUNTERRICHT ALS WERKZEUG DIDAKTISCHEP FORSCHUNG

Computer assisted instruction as a tool for Instructional Research

Address
Deutsches Institut für Internationale Pädagogische Forschung (DIFF)
Schloßstrasse 29
D6 FRANKFURT 90

Telephone
0611/771047

Director
Prof. Dr. Karl Eckel

Staff
Gerhard Richter

Financing
Deutsches Institut für Internationale Päd. Forschung;
Stiftung Volkswagenwerk (1971-1976)

Hardware
a) Company's Computer IBM 360-50
b) Hewlett & Packard 2000 F
c) University's own computer UNIVAC 1108

Software
a) Coursewriter III
b) IDF and BASIC
c) BASIC
Information stored on tape; on disk during the courses.

Audiovisual aids
Textbooks (visual representation not possible on terminal)

Criteria used for the choice of the media
Research objectives, teachers training

Project areas
- a computer course is more easily supervised
- the preparation of a computer course (didactogramme) is also more easily supervised than the usual preparation of the teacher (this applies to the class preparations during the teacher's training as well as during the period of practice teaching and subsequent teaching.

- the notation on didactogrammes (and didaktogram grammatik = didaktogrammatik) gives the student the opportunity prepare his material very thoroughly to expose this written preparation to the comments suggestions of his fellow students and teachers during seminars and thus to collaborate actively in research.

Media-based courses

- Basis physics course
  Contents : introduction to electricity
  Participants : 9th year of the secondary school
  a) 30 students
  b) 15 students
  c) 9 students
  Others are yet to take the course
- Basis mathematics course
  Contents : calculating percentages
  Participants : 7th year of secondary; professional school.
  11 students

Modes of Computer use
dialogue tutorial

Documentation

- K. ECKEL
  Unterricht mit dem Computer (I), DIFF, Frankfurt 1973
  Unterricht mit dem Computer (II)
  Bd. 1: Freiantwortanalyse und Didaktogrammverbesserung, DIFF, Frankfurt 1975
  Bd. 2: Antwortdokumentation, DIFF, Frankfurt 1974
- G. RICHTER
  Zur Verwendung der Programmiersprachen BASIC und IDF im CU-Projekt des DIFF, Mitteilungen und Nachrichten Nr. 73/74, DIFF, Frankfurt.

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10. PROJEKT FAL

Förderung des Autonomen Lernens

(Inciting individualized learning)

Address
Projekt "Förderung des Autonomen Lernens"
Universität Frankfurt
Institut für Didaktik der Physik
Gräfstrasse 39
D 6 FRANKFURT

Telephone
0611/798-2926

Director
Prof. Dr. Klaus Weltner

Staff
Dipl.-Psych. G. Kanig - Planning of experiments, evaluation, adjusting of tests

P-B. Heinrich - Didactogrammation
Dr. S. Wittig - Simulation, Analysis of contents and evaluation.

Dipl.-Phys. K. Hoffman - Analysis of contents, adjustment of tests, performing experiments

Hardware
University's and Project's own computer :
SIEMENS 4004/151
Graphical displays TEKTRONIX 4013

Software
APL 4004
APL PLUS with file system
Graphical package PLOT 10 (Tektronix)
Operating system BSV-2000 (Siemens)

Storage
500 K Byte
Disk

Audiovisual aids
Media : 1) Textbook
2) Student guide

Purpose : 1. To provide information as a starting point to individualized learning, not managed by computer;
2. Aids to individualized learning, controls and instructions, exercises, about and study of learning techniques

Criteria used for the choice of media
Pedagogical factors : the student must be able to learn by himself. Consequence : the most important part of an autonomous teaching depends on classical information sources.
Economical factors : written information is cheaper than the one given by computer
Managing factors : books and written material are more easily available and also more time-independent than a terminal.
All these 3 reasons have the same objectives : to emphasize individual learning and to use the computer (CAI) when more advantageous.

Project areas
- development of ways of helping individualized learning
- to encourage capacities for individualized learning
establishment of tests for strengths weaknesses of the capacity for individualized learning, as conditions for individual development.
- Research on the effects of particular forms of help
- Research on production of structured tests

The goal of this research is the reduction of costs of tests and an improved format for them. Fields of applications : mathematical foundations for the natural science students, application of the tests method and instructions for 6 parts of the subject:
simple functions, trigonometric functions, differential calculus, integral calculus, Taylor's series, calculus of probabilities and errors calculation.

Media-based courses

- Mathematics for physicists (basic course). 80 study hours including 12 on the computer. Contents : function concept, simple functions, trigonometric functions, exponents, logarithms, inverse functions, differential calculus, integral calculus, vectorial calculus I, vectorial calculus II, scalar product and vectorial product, Taylor series and development of exponential series, complex numbers, differential equations, many variables functions, scalar fields and vectorial fields, partial derivatives, total differential and gradient multiple integrals, coordinate systems, parametric representation of curves, differentiation following parameters, linear integrals, double integrals, divergence and rotation, transformation of coordinates and matrix, determinants and linear systems of equations, probability calculus, error calculus, wave equation, Fourier series.

Participants : students training to teach secondary level I, physics section, study of foundations (40 students)

Modes of computer use
Drill and practice, diagnostic tests, simulation, CMI , computer graphics.

Evaluation
1. system : the use of the graphic terminal TEKTRONIX is very suitable, particularly for the representation of mathematical formulas which have to be written in a formal style. These notations were explained for the first time in this project, as subroutine.

2. programs : the programs were evaluated by the students. Comparative measures using differential semantics of the courses and other forms of academic measurement.

3. students : a) performance : evaluated by tests
b) attitudes : evaluated by questionnaire.

Computer programs and connected materials

K. WELTNER (Hrsg.)
Mathematik für Physiker, 2 Bände Lehrbuch
Vieweg-Verlag Wiesbaden, 1975

K. WELTNER (Hrsg.)
Leitprogramme zu "Mathematik für Physiker",
3 Bände, Vieweg-Verlag Wiesbaden, 1975

Computer programs:

Functions
Trigonometric functions
Exponents, logarithms
Differential calculus I
Differential calculus II
Taylor series
Probability calculus
Error calculus

Other sources of information
- S. WITTIG (Hrsg.)
Beiträge zur Methodik von Studienunterstützungen, BTZ Wiesbaden 1975
- K. WELTNER
Computerunterstützung im Hochschulstudium
Integrierende Leitprogramme zur Förderung von fachlichen Studien und Studierfähigkeit
in : Freibichler (Hrsg.) : Computerunterstützer Unterricht, Schroedel-Verlag, Hannover 1974
- K. WELTNER, R. EGGENSPERGER, P-B. HEINRICH, G. KANIG, D. ROCKENBACH, S. WITTIG
Über Untersuchungen zur Verwendung verschiedener Unterstützungsformen für das Selbststudium; in : W. Arlt, L. Issing (Hrsg)
Sammelband zum 13. Symposium der GPI.

Material for informations exchange
Projektbericht 1-75 (S. Wittig) : Darstellung mathematischer Texte im rechnerunterstützten Unterricht
Projektbericht 2-75 (R. Eggensperger) : Anwendung des SPL-PLUS Filesystems und der Execute-Funktion im Rahmen eines CMI-Kurses.
Projektbericht 3-75 (R. Eggensperger) : Clusteranalytische Verfahren und ihre Realisierung in APL.
Projektbericht 4-75 (H. Freibichler) : Konzeption und Realisation eines CMI-Systems mit Hilfe von APL
Projektbericht 5-75 (P-B. Heinrich) : Auswerteverfahren zur Strukturvalidierung.
Projektbericht 6-75 (S. Wittig) : Programm LIZ, Berechnung optimaler Reihenfolgen

11. PROJEKT COMPUTER-UNTERSTUTZTER HOCHSCHULUNTERRICHT IN BIOLOGIE

(Computer Assisted Instruction as a tool for Instructional research)

Address
CUU-Vorhaben
Computer-Unterstützter Hochschulunterricht
in Biologie
der Albert-Ludwigs-Universität Freiburg
Schänzlestrasse 9-11
D 78 Freiburg

Telephone
0761/2032747/2717

Director
Prof. Dr. B.A. Gottwald

Collaborator
Dipl.-Ing. P. Ripota

Financing
Bundesministerium für Forschung und Technologie Baden-Württemberg
Projektträger DV im Bildungswesen

Hardware
SIEMENS 4004/151-J
21 terminals
1 dual magnetic tapes set with 240 KBytes/sec.
1 High speed printer
1 card reader

Software
Operating system BS 2000, PLANIT, APL-PLUS, BASIC, FORTRAN, ALGOL, COBOL, Data Bank LGU (Lernergesteurter Unterricht), SNOBOL IV, FORTRAN-LISP

Storage
Central memory 524 kByte
2 drums (4. 1 MByte each)
5 disks (55 MByte each)

Project areas
During the course of the project, the work will cover the following fields :

a) research and development of the courseware for different aspects of biology to develop a curriculum in Biology, in which the CAI/CAL will have a large role.

b) evaluation of the implemented courseware so that once the work is finished and the data and results are available, these can be used as the basis of decisions for a greater introduction of CAI/CAL in higher education.

c) research and development of off-line tests systems on one hand, to improve interaction between students and teachers during the magistral course; on the other hand, to process the statistical data about CAI/CAL , the students attitude and the results of their study.

d) Trial and development of the documentation language PAL (Primary Author's Language) as the basis for documentation on the courseware and its dissemination on the courseware and its dissemination among the institutions using different CAI/CAL softwares.

A final goal is to integrate, the CAI/CAL in the framework of the didactic center of the Gesamthochschule of Freiburg and as a center for CAI/CAL thus making it available to everyone interested.

Modes of computer use
Drill and practice, simulation, information retrieval

Computer programs and connected materials
During the 4 years of the project, about 30 programs were created for the biology students and used in the course. A list of these programs is presented in the following table (ST = corrective tests programs, UB = drill and practice, Si = Simulation, Da = data bank)

Basic studies

BIOFRA	: Applications for first year biologists	ST
GENUEB	: Exercises in genetics	ST
ZOPRAM	: Exercises in zoology - Molluscs	ST
STAMM	: Quantitative analysis of the genealogical tree	ST
PFLABE	: Exercises in plan identification	Üb
INBE	: Exercises in insect identification	Üb
ZOBE	: Exercises in identification in zoology (Molluscs)	Üb
GENKART	: Simulation for the analysis of the fine structure of genes	Si
MUBE	: Simulation for mutant identification	Si
RASFUSIM	Simulation of punctual mutations and frameshift	Si
ANVOLYSE	Inorganic analysis test	Si
EUGENIK	: Genetic game	Si
MWG	: Mass effect law	Si
ATOBA	: Mass effect law	Da
Funktionen-Lexicon - Lexicom of functions		Da

After a preliminary examination :

HEFE	: Yeast crossings	
KONJUG	Conjugations of bacteria	ST
INMU	Induced mutations	ST
SPOMU	Spontaneous mutations	ST
GECO	Genetic code	Si
GERE	Control of genes	Si
KREUZ	Exercises on the crossings of genes	Si
KLIDI	Clinical diagnosis	Si
DROS	Simulation on drosophilae	Si
OEKO	Simulation of population dynamics	Si

Preliminary term:

CUS-Chem Individualiazed computer learning of chemistry

EME Use of the slide-rule for Biologists

Other information sources
Projektträger "DV im Bildungswesen" im FEoLL, Paderborn

Materials for exchange
Jahresberichte
FEoLL Informationen 2 (1975)

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12. PROJEKT CUU MATHEMATIK

(Computer Assisted Instruction in Mathematics)

Address

Projekt CUU Mathematik
der Universität Freiburg
Hebelstrasse 29
D-78 Freiburg

Telephone
0761/203-4110

Director
Prof. Dr. M. Barner

Staff

Dipl.-Math. B. Kirst
Dipl.-Psych. W. von Stuenzner

Financing

Bundesministerium für Forschung und Technologie
End of the project at 31.12.75 for financial reasons

Hardware
Project's own computer
SIEMENS 4004/151 (524 kBytes)
2 Magnetic drums (3. 28 Mio. Bytes)
5 disks (55.4 Mio. Bytes)
1 dual magnetic tapes set
High speed printer
Card reader
Connections available for 30 terminals
(shared with Biology section)

Software
Operating system BS 2000
ASSEMBLER, APL, BASIC, FORTRAN, ICU/PLANIT
etc...

Storage
524 k
Tape and disk

Project areas
The aim of the project was to create a teaching tool on the possibilities of computer-assisted learning of mathematics.
The objectives were thus developed in relation to their suitability to CAI/CAL; the CAI/CAL strategies were examined in relation to their teaching use and new strategies were developed On the basis of different standard programs, relatively independent (but which can be united in a modular form), programmed teaching techniques were worked out these techniques were tested in teaching.
As a teaching unit, the chapter on "Integrals" of the "Analysis" course for beginners was chosen.
As a basic text, the textbook put out by the Deutsche Institut für Fernstudien (DIFF) of Tübingen was used in collaboration with the 2. Deutsche Fernsehen (ZDF). This textbook is "Einführung in die Intergralrechnung" (Introduction to the integral calculus)
Introductory tests developed as well as a program connected to the lecture
The program accompanying the course is conceived of as an information system (data bank). A rather important series of exercices complete it, helping the student in solving the exercises himself. Thus the CAI/CAL system is useful not only for basic learning, but also in drillings in repetitions and it is at the individual control of the student.
These transition programs from secondary school to higher education must not only assist the student and help him to adapt his learning. They can also teach him techniques and strategies that he can use to assimilate by himself a new subject. They are used also to motivate him so that he can acquire a good habits of work and reflexive thinking in mathematics.
The subjects are designed such that all the students who require some particular assistance can find a personally adapted program. The program must also be available to students during vacations as a preparation and parallel to superior courses .
This personalized instruction can be broadened and deepened because the same difficulties come up at the beginning of each year. Besides, these difficulties are independent from the institution in which the student has studied.

Modes of computer use.
Drill and practice, simulation, games, problem solving, computer augmented lectures, autoevaluation tests

Evaluation
is made by questionnaires and student records

Computer programs and accompanying material
About 20 mathematics programs for beginning to advanced students.
Type of programs : autoevaluation tests, tutorial, interactive dialogue, etc...
The present programs are used by about 50 students

- MVT (Mathematics. Preliminary test on integral calculus)
- MADE (Mathematics Demonstration of a information system)
- MINDU (Mathematics, inductions)
- MTUP (Mathematics
- GRUPPE (Mathematics, groups theory)
- MAKON (Mathematics, complex numbers)
- MLEX (Mathematics, logarithms and exponential functions)
- DOPPLER (Doppler's effect)
- MAC (Begin of calculus mode)
- MEIN (Mathematics, introduction to the terminal's work)

Other sources of information
Projektträger "DVim Bildungswesen" im FEoLL, Paderborn

Material for the exhange of information
FEoLL Information 2, Paderborn 1975

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13. PROJEKT CUU AN FACHHOCHSCHULEN (CAI PROJECT IN FACHHOCHSCHULEN)

Address
Forschungsgruppe CUU
Fachhochschule Furtvangen
D-7743 Furtwangen

Telephone
07723/2051

Director
Prof. Dr. Ernst G. Wrage

Staff
Ing. Bernd Clemens
Dipl.-Math. Andreas Hess
Dipl.-Ing. Peter Ripota
Dipl.-Math. Ingeborg Roth
Ing. Walter Schneider
Ing. Bernhard Schöner

Financing
DV im Bildungswesen für Bundesministerium für Forschung und Technologie

Hardware
University's own computer : DEC 1050
Card reader, 2 printers, 40 terminals (aslso graphical), corves plotter,
Time sharing operating system.

Software
All languages (including APL)

Storage
160 K words at 36 Bits
Tape and disk

Audiovisual aids
Graphical display (see hardware)

Criteria used for the choice of the media
Pedagogical factors
No time problems due to computer's capacity

Project areas
Development of university courses (for basic subjects) as well as for specialised and advanced branches. Mainly in the fields of electronics and data processing

Media-based courses
- Measurement systems : basic material for all engineers (about 50 students)
- SPICE, bases of electronics, basic and specialised material for electrotechnicians (about 100 students)
- Analog and model calculators, advanced and specialised branches for electrotechnicians (about 50 students)
- CAI/CAL with SPICE for the electrical branches specialised branches for electrotechnicians (± 200 students)
- Complex numbers, basic course for all engineers (about 100 students).
- Rudiments of construction in digital electronics and data processing. Basic study and specialised branch for electrotechnicians. (about 100 students)
- Dynamic systems, specialised branch for all engineers (± 50 students)
- APL programming, basic study and specialised branch for all engineers; mainly EDP specialists (about 50 students)
- Teaching of BASIC, basic study for all engineers, mainly EDP specialists (about 100 students).
- Simulation of discrete models in time, basic study and specialised branch for EDP specialists in economics (about 50 students)

Modes of computer use
Dialogue tutorial, drill and practice, simulation, games, problem solving, computer-based laboratories, computer augmented lectures, computer graphics.

Evaluation
1. system : time-sharing = excellent
2. programs : students worked freely and willingly
3. students : performance : adequate
   attitudes : positive

Computers programs and accompanying material
packages

Other sources of information
Reports at the end of the year

E. WRAGE (Hrsg.) : Bericht CUU an Fachhochschulen-Furtwagen, 1975